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Engineering with Rubber

How to Design Rubber Components

2nd Edition

Edited by Alan N. Gent

With contributions by
R. P. Campion, M. D. Ellul, R. H. Finney, A. N. Gent,
G. R. Hamed, D. L. Hertz, Jr., F. O. James, G. J. Lake,
T. S. Miller, K. W. Scott, P. M. Sheridan, J. G. Sommer,
A. Stevenson, T. Sueyasu, A. G. Thomas, C. Wang, O. H. Yeoh

HANSER

Hanser Publishers, Munich

HanserGardner Publications, Inc., Cincinnati

Editor:
Dr. Alan N. Gent, Polymer Science 3909, The University of Akron, Akron OH 44325-0309, USA

Distributed in the USA and in Canada by
HanserGardner Publications Inc.
6915 Valley Avenue, Cincinnati, Ohio 45244-3029, USA
Fax: +1 (513) 527-8950
Phone: (513) 527-8977 or 1-800-950-8977
Internet: http://www.hansergardner.com

Distributed in all other countries by
Carl Hanser Verlag
Postfach 86 04 20, 81631 München, Germany
Fax: +49 (89) 98 48 09
Internet: http://www.hanser.de

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Library of Congress Cataloging-in-Publication Data

Gent, Alan N.
Engineering with rubber / Alan N. Gent.
p. cm.
Includes bibliographical references and index.
ISBN 1-56990-299-2 (hardcover)
1. Rubber. 2. Engineering design. I. Title

TA455.R8 G46 2000
620.1'94–dc21 00-061782

Die Deutsche Bibliothek–CIP-Einheitsaufnahme
Engineering with rubber : how to design rubber components / Alan N. Gent.–2. ed..–Munich : Hanser; Cincinatti : Hanser Gardner, 2001
ISBN 3-446-21403-8

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Typeset in the UK by Marksbury Multimedia Ltd, Bath, Avon
Printed and bound in Germany by Kösel GmbH, Kempten

Preface

Components based on rubbery materials play a very important part in engineering processes and products. Springs and snubbers, seals and gaskets, hose and belting, friction drives and roll covers – a comprehensive listing of essential rubber components would be surprisingly long. And yet, in spite of this widespread and necessary use of rubber in engineering, a general working knowledge of rubber science and technology is rather uncommon. Because they have little information or experience to guide them, design engineers tend to treat rubber as a suspicious and unreliable material, to be avoided if possible. But in many cases, use of a rubber part gives a simple and elegant solution to a major engineering problem. Recent examples are rubber bearings for road bridges, allowing for thermal expansion of the bridge deck without putting excessive loads on the bridge supports; rubber springs transmitting power to helicopter blades and simultaneously providing specified (and different) stiffnesses in various directions, to permit changing inclination of the blades; and rubber supports for buildings, to protect the structure against subsurface movements in earthquakes.

Information on design and application of rubber components ought to be part of a general engineering education, along with the study of other materials, so that the new engineer can make intelligent design choices. Without this knowledge, he or she is completely dependent on the rubber manufacturer or supplier for product design and technical information.

This book is intended to meet the need for such information–to teach the beginning engineer the principles of rubber science and technology: what rubber is, how it behaves, and how to design simple engineering components. This book does not deal with *tire design* – a complex subject involving properties of vehicles and roads, as well as rubber technology. Nevertheless, tire designers may certainly benefit from this material, even though their needs have not been specifically addressed.

This book deals with some basic principles on which successful use of rubber depends:

- How is an elastomer chosen and a formulation developed?
- Why is rubber highly elastic and relatively strong?
- How can one estimate the stiffness, strength, and durability of rubber products?

These questions face any engineer who wishes to understand the principles of designing rubber components. The authors have extensive personal experience in rubber science and technology. In many instances they have provided sample problems and questions to allow readers to gauge for themselves how well they have mastered the material. In fact, the contents of the book could well be incorporated into a senior undergraduate or beginning graduate course in materials science and engineering.

In large part, this book owes its existence to the Rubber Division of the American Chemical Society, and in particular, to the vision of the former chairman of the Education Committee, Mr. Daniel L. Hertz, who recognized the need for a monograph on this subject and took a leading role in securing an editor and authors.

A. N. Gent
Akron, Ohio

Preface to Second Edition

The authors undertook some years ago the task of assembling information on rubber as an engineering material – information that is either widely dispersed in technical papers or not currently in the public domain. Their efforts resulted in the first edition of this book. Now a second edition is called for. It has provided an opportunity to correct misprints and errors, and the authors are greatly indebted to readers who pointed them out, especially to Mr. Jim Goodson of Baker Oil Tools and Prof. Gong Ji Qiu of Shanghai Tiedao University, China. We would appreciate hearing about any that remain.

This second edition contains revised and updated information and many new problems that deal with specific issues and allow readers to test their understanding of the material. In fact, questions are now at the end of nearly every chapter. This feature should be especially useful to students.

The plan and format of the book are otherwise unchanged. The subject of rubber in engineering is treated by authors with broad experience in rubber technology and, in particular, in engineering applications. We hope that the book continues to prove valuable both to students and to practicing engineers who must deal with this unusual, fascinating, and essential engineering material.

A. N. Gent
Akron, Ohio